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ABSTRACT

Twenty-one children (approximate ages 6 to 16), drawn from the larger pool of 100, with Tourette's Syndrome were evaluated to: (1) determine the prevalence of learning disorder in this population; (2) identify particular areas of academic difficulty; and (3) consider the spectrum of central nervous system processing deficits in these children. Not one subject achieved at or above expectancy in all seven of the academic tests given, and only four had a discrepancy in only one area. The greatest number of failures were in spelling (71 percent) and writing (62 percent). Approximately half had difficulty with calculation, about 28 percent had difficulty in word identification, and 24 percent in reading comprehension. Problems in written expression were correlated with visual-motor difficulty. (Contains 20 references.) (DB)

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Tourette's Syndrome and Learning Disorders**

Deborah Harris, Ph.D., Archie A. Silver, M.D. and Habir Sekhon, M.D.*

It is generally agreed that disorders in learning constitute a significant problem for children with Tourette's syndrome. Comings and Comings (1987) report that compared to their control sample, children with Tourette's syndrome are placed in special classes in significantly greater numbers, require greater special tutoring and, using the Comings' criteria, "dyslexia" was found in 26.8% of their Tourette patients compared with 4.2% of their controls. In a later paper Comings, Himes, *et al* (1990) found that 70% of students with Tourette's syndrome were in special education classes and 12% of children in special education classes had Tourette's syndrome. If all probable and possible cases of Tourette's syndrome were included, then 28% of all children in special education classes manifested Tourette's syndrome. The authors concluded that "Tourette's syndrome is a common, often misdiagnosed disorder which has significant impact on school performance" (p.463). Larer (1987) categorically states that "one-half of the children with Tourette's syndrome have specific learning disabilities, perceptual-motor problems, attention deficit disorders, hyperactive behavior and abnormalities of psycho-educational testing" (p. 267). More specifically, Hagin and Kugler (1988), in a sample of 26 subjects ranging in age from 7 years to young adulthood, found that in group tests of reading, 68% of her sample earned scores below expectancy but when individual tests of reading comprehension were given, the percentage of sample earning scores

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below expectancy fell to 40% In tests of spelling, however, 52% scored below expectancy while in mathematics 56% were below expectancy. These data are in contrast to those of Bornstein (1990) who, using the Wide Range Achievement tests, found 12% of her sample of 100 children age 6-18 years, to earn scores 1.5 standard deviations or less below normative standards in reading, 16% in spelling and 17% in arithmetic. The academic achievement of children with Tourette's syndrome requires further exploration.

There is also scant data on the neuropsychological processing deficits in these children. There is evidence that as a group, when compared to their peers, children with Tourette's syndrome obtained lower scores on the Coding subtest of the Wechsler's Intelligence Scale for Children-Revised (WISC-R). Hagin and Kugler (1988), found 40% of their subjects had Coding subtest scores significantly below their mean scaled scores. Coding was also the lowest subtest score found by Thompson (1978) in four children with Tourette's syndrome, by Incagnoli and Kane (1982) in 13 children with Tourette's syndrome. Harcherik *et al* (1982) also found coding (digit symbol B) along with handwriting and with difficulty adapting to changes in speed of a road-tracking test, to be the major cognitive deviation from normal in a sample of 15 children ages 7 to 15 with Tourette's syndrome. The Coding subtest, measuring speed and accuracy in associating visual symbols, using a written response may reflect a visual-motor-praxic problem. Bornstein (1990) found that approximately 20% of her sample obtained scores suggesting impairment in sensory-perceptual tasks where the mean scores for both hands on tests of finger-gnosis and graphesthesia and on psychomotor tests (Tactile Performance Test Time on the Halstead-Reitan Battery) were "well below normative standards".

The reasons for these findings are not yet clear. Some of the learning problems may be directly related to the symptoms of Tourette's syndrome itself: difficulty with sustained attention, impulsivity, obsessive thinking which may not permit the child to move freely from one thought to another; compulsive behavior which traps him into rituals such as tapping, touching,

erasing; increased anxiety which may result in poor sleep, morning fatigue, school refusal, specific phobias, perseveration, echolalia and palilalia and the motor tics themselves. The emotional and social consequences of these symptoms contribute to poor school adjustment and academic achievement, and medication may, itself, contribute to decreased cognitive function, depression, anxiety and school phobia (Silver and Hagin, 1990, pp 488-489). In addition, however, it is not known whether the neuropsychological processing deficits found in specific learning disabilities may be found in children with Tourette's syndrome and contribute to their learning problems.

The data reported in this presentation is part of a larger study of the educational aspects of Tourette's syndrome conducted at the University of South Florida as a joint investigation by the College of Education and the Department of Psychiatry and Behavioral Medicine of the College of Medicine. This report will attempt to answer the following questions:

1. What is the prevalence of learning disorder as measured by discrepancies between academic achievement and academic expectancy in children and adolescents with Tourette's syndrome?

2. What areas of academic difficulty can be identified in these children?

3. What is the spectrum of central nervous system processing defects in these children?

Method

Subjects of the overall study are 100 children and adolescents, boys and girls, ages 5 to 18 consecutive admissions to the Tourette's syndrome clinic of the Division of Child and Adolescent Psychiatry in the Department of Psychiatry at The University of South Florida College of

Medicine. All subjects will have met the DSM-III-R criteria for the diagnosis of Tourette's syndrome as determined independently by the clinic director (Archie A. Silver, M.D.) and one additional Board Certified Child and Adolescent Psychiatrist. The criteria for the diagnosis of Tourette's syndrome includes: (1) The presence of multiple motor and at least one vocal tic sometime during the illness, although not necessarily occurring concurrently; (2) The occurrence of tics at variable times over the period of at least one year. The tics may vary in anatomic location, number, frequency and complexity. Problems of attention difficulty, hyperactivity, impulsivity, obsessions and compulsions, anxiety and depression may be present. Exclusionary factors for this study are evidence of a structural defect of the central nervous system, seizure disorders, or other physical illness as determined by history, physical examination, and laboratory study. An abnormal EEG without evidence of a structural CNS defect or seizure disorder is not cause for exclusion.

With the consent of their parents, all subjects will be individually examined in a protocol which includes: (1) Demographic factors including a detailed family history with particular emphasis on disorders of motility, obsessive-compulsive disorders, school difficulty, academic achievement, anxiety and depression. (2) The development and current picture of Tourette's syndrome; the anatomical location of tics, frequency, complexity, severity. A Tourette's Syndrome Symptom List (Cohen *et al*, 1985) completed by parent, staff, and where possible the patient himself; a Tourette Syndrome Global Scale (Harcherik *et al*, 1984) will be completed by our staff. (3) Neurological, neuropsychological and psychiatric examinations. This includes not only the classical neurological evaluation but also "soft signs" which probe neuropsychological processes: body image (finger-gnosis, praxis, right/left discrimination, extinction phenomena), and central processing functions in visual and auditory areas relating especially to spatial orientation and temporal organization of language. (4) Wechsler Intelligence Scale for Children-Revised (WISC-R) scores and academic achievement scores measured by the Woodcock-Johnson Tests of Academic Achievement-Revised (WJ-R). The

specific tests of the WJ-R battery include: Letter-Word Identification (test #22), Passage Comprehension (#23), Calculation (#24), Applied Problems (#25), Dictation (#26), Word Attack (#31), and Writing Fluency (#35). All educational tests are individual ones, done by Dr. Deborah Harris. The WISC-R testing will be done by various psychologists all certified as examiners by the State of Florida Board of Professional Learning. Scores on the WJ-R will be transposed into age equivalents and into grade equivalents as determined by the WJ-R norms. The decision as to whether or not a specific test score is at, above, or below expectancy will be determined using the Harris formula (A.J. Harris, 1970, pp. 208-216) and the Full Scale I.Q. on the WISC-R. The Full Scale I.Q. is used, rather than the Verbal or Performance scores because using Verbal or Performance I.Q. alone may under-rate expectancy since the learning disorder alone may depress either of these scores. Full Scale I.Q. offers a level of expectancy for overall achievement. Using grade level discrepancies alone may preclude inclusion (i.e., under-identify) children in the higher I.Q. levels, and standard score comparisons do not take into account regression of I.Q. scores on achievements scores. The Harris formula is used because it considers both mental age and chronological age in estimating expectancy and has proven reliability and validity:

$$\text{Achievement Expectancy Age} = \frac{2MA + CA}{3}$$

These may be expressed in months.

An achievement quotient is obtained by dividing the actual achievement age by the achievement expectancy age:

$$\text{Achievement Quotient} = \frac{\text{Achievement Age} \times 100}{\text{Expectancy Age}}$$

The difference between achievement and expected achievement is considered within normal limits when the *expectancy* achievement quotient is between 90 and 110. The lower the quotient

the more severe the disorder. Accordingly, in this report, all achievement quotient scores below 90 are considered below expectancy; 90 or above are considered at or above expectancy. A discrepancy of 1.45 standard deviations between actual and expected achievement is a guide for eligibility for special services by the school system (PL 94-142, and revised in PL 101-476).

This study will report on the educational achievement of 21 children drawn from the larger pool of 100. They were chosen only because they had completed the entire assessment battery, specifically, the educational tests (WJ-R) and the cognitive test (WISC-R). It may well be that one factor prompting the completion of their testing was their living within commuting distance of the University of South Florida. The age of this smaller group ranged from 6 years, 8 months to 15 years, 11 months, with 57% of the children 11 years of age or greater. Their Full Scale I.Q. on the Wechsler Intelligence Scale for Children-Revised ranged from 71-139, Verbal I.Q. from 65-140 (mean 100.7), Performance I.Q. from 81-143 (mean 99.5). There were 2 girls in this group.

Results

Comparison of educational expectancy with educational achievement may be seen in Table I and in Figure 1. Overall there was not one subject in this group who managed to achieve at or above expectancy in all the academic tests given and only 4 of the 21 had a discrepancy in only one subject area. Kenneth, age 11-6, with a Full Scale I.Q. of 107 (Verbal 100, Performance 109) earned an achievement quotient (A.Q.) of 100 or above in all academic tests except spelling (dictation) where his achievement quotient was 86. Amanda, age 9-2, with a Full Scale I.Q. of 109 (Verbal 108, Performance 109) also was lower than expected in spelling (quotient 89). Josh, age 11-4, with a Full Scale I.Q. of 127 (Verbal 130, Performance 115) had a quotient of 88 on writing. Evan, age 14-11, with a Full Scale I.Q. of 91 (Verbal 93,

Performance 84) was able to achieve at a high level in all academic areas with his lowest achievement quotient at 115 in reading and in spelling but who was not able to attain a quotient above 89 in writing. On the other hand, there were only two subjects whose achievement was below expectancy in *all* the tests of the WJ-R. James, age 14, with a Full Sale I.Q. of 71 (Verbal 65, Performance 81) earned an achievement quotient of 66 in word recognition, 58 in comprehension, 66 in calculation, 55 in word problems, 67 in spelling and 67 in writing. Clarence, Age 16-3, with a Full Scale I.Q. of 81 (Verbal 78, Performance 89) earned scores just above half of expectation in reading, writing and spelling but was able to earn an achievement quotient of 75 in calculation. Each of these boys had Verbal I.Q. significantly lower than their Performance, had severe compulsions, and had neuropsychological processing deficits similar to those seen in children with specific learning disabilities. Each was attending classes for the severely emotionally disturbed.

As a group, the greatest number of failures was in spelling and in writing; 71% were below expectancy in spelling, 62% in writing, in contrast to 29% at or above expectancy in spelling and 38% in writing. These are significant discrepancies. On the other hand looking at word identification skills and reading comprehension, the Tourette's children as a group did much better than they did in spelling and in writing. Twenty-eight percent were below expectancy in word identification, 24% in comprehension, while 72% and 76% of the group were at or above expectancy in word and reading and reading comprehension respectively. Solving of word problems was difficult for 33% of the group in contrast to 75% achieving expectancy. Approximately half of the group did have calculation difficulty but the same number did not.

With the mean expectancy achievement score at 100 with a standard deviation of 15, the mean scores actually achieved by the entire sample in spelling and in writing were 85.23 and 83.67, respectively. These are significant discrepancies (Table 1), using the t test. On the other hand, looking at word identification skills and reading comprehension, the Tourette's children as a

group did much better than they did in spelling and in writing. The mean score achieved by the Tourette's syndrome children in word identification was 101.14 and in comprehension 113.36 . In the area of mathematics, solving of word problems was only slightly below the mean with a mean achievement score of 96.05. Calculation also presented some difficulty for our sample with a mean achievement score of 91.25. Summarizing the results using t test, significant differences between the expectancy and actual achievement of Tourette's children was found in writing (p. <.05), in spelling (p. <.003), and in calculation (p. <.01).

Contrasting these findings with those in the literature (Table II), word identification in our sample was slightly more impaired (28%) than that of Hagin-Kugler (1988) at 16% and that of Bornstein at 12%, but equal to the findings of Comings and Comings (1990) of 26.8%. Reading comprehension, however, was significantly different at 29% in our group, 40% in the Hagin-Kugler group. Calculation was approximately the same percentage of difficulty in our group (48%), compared to 56% in the Hagin-Kugler study but was significantly more impaired than Bornstein's 17%. Spelling was significantly worse in our group at 71%, compared to 52% for Hagin-Kugler and 16% for Bornstein's. These variations may be a function of sampling and of testing methods. The Fordham investigators studied children and young adults referred to a School Consultation Center because they were already experiencing school difficulty. The Bornstein subjects were volunteers recruited from the Tourette's Syndrome Association of Ohio, while our subjects were patients whose Tourette symptoms, usually tics and/or compulsions, were the motivating factor in their coming to a medical clinic.

What emerges from these studies is that spelling and writing are significant problems in 3 of 4 children and adolescents with Tourette's syndrome; that approximately half of them will have difficulty with calculation, but that approximately 1 of 4 will have difficulty in word identification and in reading comprehension. Whether the reading difficulty in Tourette's syndrome is significant when compared to a control population is not at all clear. What is clear

is the association of Tourette's syndrome with visual-motor difficulty, with spelling difficulty and less so, although still greater than a normative sample, in mathematics.

The visual-motor difficulty, so prominent in this sample, however, does not appear to spring from similar causes, but varies in origin and in characteristics. Some resemble the spatial processing deficit found in specific learning disabilities, some are trapped in the compulsions and/or in the motor tics of Tourette's syndrome itself. Another group of children have visual-motor tasks driven by hyperkinesis as seen in children with Attention Deficit Hyperactivity Disorder. Amando, for example, was 9 years, 9 months of age and in the 6th grade when he was first seen by us. He had multiple motor and phonic tics, a rigidity of personality, and in spite of an overall WISC-R I.Q. of 112, he had difficulty in word recognition, in spelling and in handwriting. His Bender-Gestalt productions were typical of many children with specific learning disabilities. All figures were verticalized as much as 90° so that rather than placed horizontally on the page, they appeared to be standing on end. He also had difficulty with the diamond in Figure A. Recommendations for remedial education was made, the tics were brought under control with haloperidol, but we did not see Amondo again until 3 years later, when he was 12 years, 10 months of age and still struggling academically. The characteristics of his visual-motor function at age 12-10 were similar to those seen at age 9-9: verticalization and angulation. Indeed, the angulation problems seen in Figure A of the Bender-Gestalt actually appeared less mature than that seen 3 years earlier.

Evan, who was described as being able to function in all academic tests except in handwriting, had first been seen when he was 9 years, 1 month of age. His visual-motor function as seen in the Bender-Gestalt test, revealed the verticalization and angulation problems found in Amondo. Handwriting continued to plague Evan throughout the years. David at 12 years, 10 months of age, in the 7th grade, earned a Full Scale I.Q. of 120. His reading achievement, comprehension, word problems were above expectancy; his calculation and spelling, although about grade level,

were not above expectancy while his handwriting was below expectancy. Visual-motor function was not marked with the verticalization seen in Amando and in Evan; but most striking was a primitive quality to the work of this bright 13-year-old, with perseveration, whorls for dots, and with the figures drawn from right to left, rather than from left to right. Clarence with his Full Scale I.Q. of 81 also demonstrated perseveration but he had none of the primitive features demonstrated by David. The combination of perseveration with angulation problems is not unusual as seen also with Michael, a 13 year, 7 month old, 8th grader who although earning a Full Scale I.Q. of 103 (Verbal 108, Performance 98) is failing spelling, avoids doing his written work and already feels that his brain is worthless and that all he can become is a garbage man. His Bender-Gestalt figure reveals preservation and difficulty with angles but also offers clues to his emotional state where his Figure 2 of the Bender-Gestalt trails off into nothing.

Where the errors seen in the Bender-Gestalt test are not similar to those seen in specific learning disability, motor tics may make the lines of visual motor tasks uneven and make the physical task of writing difficult or the impulsivity associated with Tourette's syndrome and with ADHD creates a wild and illegible scrawl. John for example, a second grader at 8 years and 4 months has a Full Scale I.Q. of 113 (Verbal 103, Performance 123), cannot sit still. He has facial tics, eye blinking, grimacing and frequent high pitched squeaky vocalizations. He was receiving no medication. His visual-motor performance is characterized by its impulsivity, his attempts to contain each figure in a circumscribed area. The verticalization and angulation problems of SLD are not apparent, however. What emerges from examination of these visual-motor productions is their variability, responsive to the symptoms of Tourette's syndrome but also as retaining many of the immature features in verticalization and in angulation seen in children with specific learning difficulty. If, indeed, the prevalance of SLD is higher in Tourette's syndrome than in the "normal" population, then there may be a genetic association

between the two disorders. The high family incidence of SLD and of Tourette's suggests that this probably needs further explanation.

From a practical point of view, however, the data have *significance for education.*

Our data suggest that difficulties in written expression are common in children with Tourette's syndrome. While the source of difficulty varies, patterns of academic performance are similar. The patterns noted in our data included, shortened sentences, misspelled words, poorly formed letters, spacing problems, incomplete thoughts and gross punctuation errors. While students were completing the written tasks required in this test, frustration and stress were obvious. Students also appeared to get "stuck" several times during the test as they attempted to write what they were thinking. This contributed to significant lags in completing the tasks within the allotted time frame. These patterns of performance were evident across age, grade and ability levels. For example, David, an extremely bright 7th grade student, performed well above average in most areas except written expression. His written language score indicated performance well below expected achievement. David's written products were very similar to children whose grade levels and abilities indicated a second grade functioning level. Written tasks evoke frustration, contribute to his unwillingness to participate in writing activities, and result in repeated failure.

What appears to underlie the difficulties in written expression in children with Tourette's syndrome is visual-motor dysfunction. While the cause of this dysfunction may also vary, the overall effect may be more than in writing itself. "Severe visual-motor defects" (Johnson, 1988, p. 122) "can interfere with a persons ability to convey ideas to others." Children with disorders in written expression write shorter, fewer sentences (Houck & Billingsley, 1989), make considerable mechanical errors (Thomas, Englert & Gregg, 1987), cannot develop a coherent thought process to produce a cohesive story (Barenbaum, Newcomer, & Nodeine,

1987), and have no memory for common words (Smith, 1988). Smith (1988), also states that children with disorders in written expression tend to write very large because they cannot control the pencil enough to write small or they hold pencil too tightly. The process of writing for students with written expression disabilities is incredibly slow and may tend to forget how to form letters so they often use their own illegible system in an effort to compensate (Smith, 1988). Retrieval problems in spelling may be imposed by mechanical difficulty in writing (Wing and Baddelly, 1988). These accumulated challenges may appear insurmountable and as a result many of these students avoid writing (Vacc, 1987).

This problem is magnified when one considers the difficulties children with Tourette's syndrome may experience. First, information processing difficulties may exist as a function of specific learning disability; secondly, obsessive thoughts, characteristic of children with Tourette's syndrome, may make it difficult for the child to change "set", traps him into repeating a single element of an assigned task and prevents him from completing it;. Thirdly, the motor tics themselves make writing difficult; fourthly, the medication used for Tourette's syndrome may interfere with visual-motor function.

While close attention has been given to how teachers can remediate writing and spelling difficulties, many schools continue to view writing and spelling instruction secondary to other subject areas such as reading and math. As a result many children and adults continue to experience failure in school because they lack necessary writing and spelling skills. Teachers tend to grade student's work on the basis of spelling, grammar, and form rather than creativity or quality of ideas (Johnson, 1988). Direct instructional approaches to remediating writing and spelling deficits are essential to the success of students with disorders of written expression (Graham and Harris, 1988).

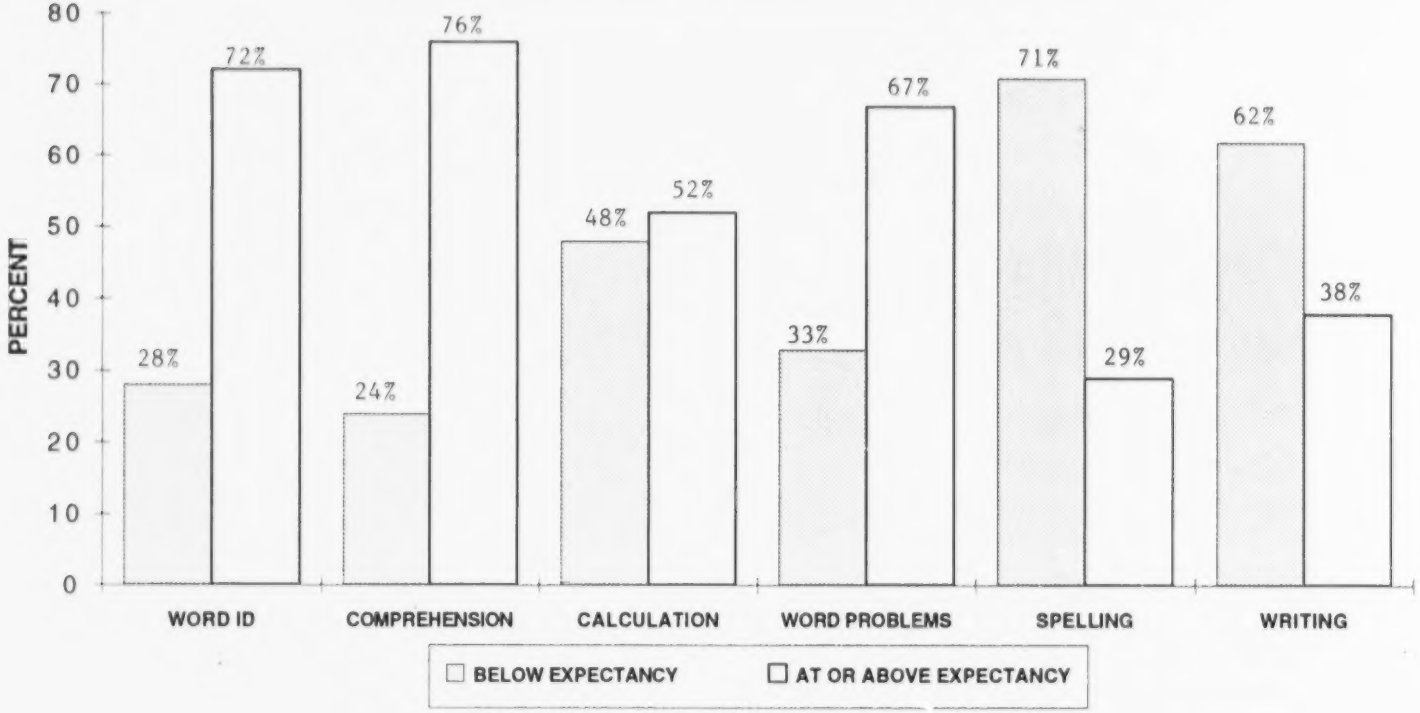
This is especially true of children with Tourette's syndrome. Educators typically respond to the more obvious symptoms of Tourette's syndrome while ignoring the existence of a specific learning disability. This has resulted in many children with Tourette's syndrome being inappropriately placed in classes for children with emotional handicaps. The outcome of these inappropriate placements, which usually do not address the specific learning disability, result in extreme frustration in children and parents and frequent educational failures for the child. Time constraints must be waived for obsessive and compulsive children. Compensatory measures to avoid written work may be used.

In summary: This study reports on the educational achievement of a group of 21 children and adolescents with Tourette's syndrome, age range 6 years, 8 months to 15 years, 11 months (mean at 11 years, 6 months), Full Scale I.Q. ranged from 71 to 139, Verbal I.Q. mean 100.7, Performance I.Q. mean 99.5. Not one subject managed to achieve at or above expectancy in all academic areas studied. The greatest difficulty was found in writing (62% below expectancy) and in written spelling (71% below expectancy).. By contrast 28% were below expectancy in word identification, 24% in reading comprehension. Approximately half the group had difficulty with calculation. The mean scores in writing, in spelling, and in calculation were significantly below expectancy.

Problems in written expression were correlated with visual-motor difficulty. The reasons for the visual-motor dysfunction were varied; verticalization and angulation difficulty similar to those found in specific learning disabilities, perseveration, obsession and compulsion, and motor difficulty because of tics themselves were found. Understanding the problems behind the visual-motor difficulties was emphasized. Educational intervention appropriate to the source of the writing problems is strongly recommended.

FIGURE 1

EDUCATIONAL ACHIEVEMENT & EDUCATIONAL EXPECTANCY IN TOURETTE'S SYNDROME



N=21 FOR EACH TEST

TABLE I

COMPARISON OF EDUCATIONAL EXPECTANCY AND EDUCATIONAL ACHIEVEMENT

Subject	N	Mean Acheivement Score	SD	T-Test	P-Value
Word Identification	21	101.14	24.08	.21	p <.83
Comprehension	19	113.36	35.31	1.65	p <.11
Calculation	20	91.25	14.01	-2.79	p <.01*
Word Problems	20	96.05	17.14	-1.03	p <.31
Spelling	18	85.23	13.78	-4.54	p <.003*
Writing	18	83.67	23.08	-3.00	p <.05*

*Significant

TABLE II

PERCENT BELOW EXPECTANCY COMPARED WITH LITERATURE

	Harris & Silver (1993	Hagin & Kugler (1988)	Bornstein (1990)	Comings & Comings (1990)
Word Identification	28	16	12	}
Comprehension	24	40		}26.8
Calculation	48	56	17	}
Word Problems	31			
Spelling	71	52	16	
Writing	62		52	

Bibliography

Barenbaum, E., Newcomer, P., and Nodine, B. (l987). Children's ability to write stories as a function of variation in tasks, age and developmental level. ***Learning Disability Quarterly***, 10:175-188

Bornstein, R. A. (1990). Neuropsychological Performance in Children with Tourette's syndrome. *Psychiatric Research, 33*:73-81.

Comings, D.E. and Comings, B.G. (1987). A controlled study of Tourette syndrome; I: Attention deficit disorder, learning disorders and school problems. *Am. J. Human Genetics, 41*:701-741.

Comings, D.E., Himes, J.A., and Comings, B.G. (1990). An epidemiological study of Tourette's syndrome in a single school district. *J. Clinical Psychology, 51*:463-469.

Graham, S. and Harris, K. (1988). Instructional Recommendations for Teaching Writing to Exceptional Students. ***Exceptional Children*** 54(6):506-512.

Graham, S. and Voth, V.P. (1990). Spelling Instruction: Making Modifications for Students with Learning Disabilities. ***Academic Therapy*** 25(4):447-457.

Hagin, R. and Kugler, J. (1988). School problems associated with Tourette syndrome. In D. Cohen, R. Bruun and J. Leckman (eds.), Tourette's Syndrome and Tic Disorders (pp. 223-236). Wiley, New York.

Harcherik, D.J., Leckman, J.F., Detlor, J., Cohen, D.J. (1984). A new instrument for clinical studies of Tourette's syndrome. *J. Am. Acad. Child. Psychiatry, 23*:153-160.

Harris, A.J. (1970). How to Increase Reading Ability (5th Edition), David McKay, New York.

Hendrickson, H. (1988). Spelling: A Visual Skill. ***Academic Therapy,*** 23(4):389-395.

Houck, C., and Billingsley, B. (1989). Written Expression of Students with and With Learning Disabilities: Differences Across the Grades. ***Journal of Learning Disabilities,*** 22(9):561-591.

Incagnoli, T. and Kane, R. (1982). Neuropsychological functioning in Tourette syndrome. In A. Friedhoff & T.N. Chase (Eds.), Advances in Neurology, Vol. 35 (pp. 305-309). Raven Press, New York.

Johnson, D. (1988). Review of Research on Specific Reading, Writing, and Mathematics Disorders. In Kavanagh, J. & Truss, T. (Eds.) **Learning Disabilities: Proceedings of the National Conference.** York Press, Maryland.

Lerer, R.J. (1987). Motor tics, Tourette syndrome and learning disabilities. *J. Learning Disabilities, 20*:266-267.

Processes in Spelling, New York, Academic Press.

Silver, A.A. and Hagin, R.A. (1990). Disorders of Learning in Childhood, Wiley, New York.

Smith, S. (l988.) Typical academic problems of learning disabled children. ***Pointer,*** 32(3):8-10.

Thomas, C., Engler, C. and Gregg, S. (1987). An analysis of errors and strategies in the expository writing of learning disabled students. ***Remedial and Special Education,*** 8:21-30.

Vacc, N. (l987). Word processor versus handwriting: A Comparative Study of Writing Samples Produced by Mildly Mentally Handicapped Students. ***Exceptional Children***, 54(2):156-165.

Wing, S., and Baddelly, A. (1980). Memory and spelling. In Frith, U. (Ed.), **Cognitive**